



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education  
Advanced Subsidiary Level and Advanced Level

**MATHEMATICS**

**9709/04**

Paper 4 Mechanics 1 (M1)

**May/June 2008**

**1 hour 15 minutes**

Additional Materials:      Answer Booklet/Paper  
   Graph Paper  
   List of Formulae (MF9)



**READ THESE INSTRUCTIONS FIRST**

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Where a numerical value for the acceleration due to gravity is needed, use  $10 \text{ m s}^{-2}$ .

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 50.

Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

This document consists of 4 printed pages.



**1** A particle slides down a smooth plane inclined at an angle of  $\alpha^\circ$  to the horizontal. The particle passes through the point  $A$  with speed  $1.5 \text{ m s}^{-1}$ , and  $1.2 \text{ s}$  later it passes through the point  $B$  with speed  $4.5 \text{ m s}^{-1}$ . Find

(i) the acceleration of the particle, [2]

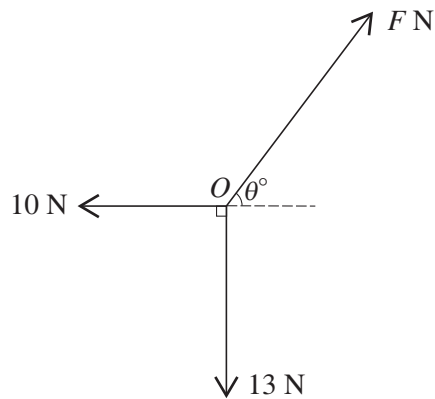
(ii) the value of  $\alpha$ . [2]

**2** A block is being pulled along a horizontal floor by a rope inclined at  $20^\circ$  to the horizontal. The tension in the rope is  $851 \text{ N}$  and the block moves at a constant speed of  $2.5 \text{ m s}^{-1}$ .

(i) Show that the work done on the block in  $12 \text{ s}$  is approximately  $24 \text{ kJ}$ . [3]

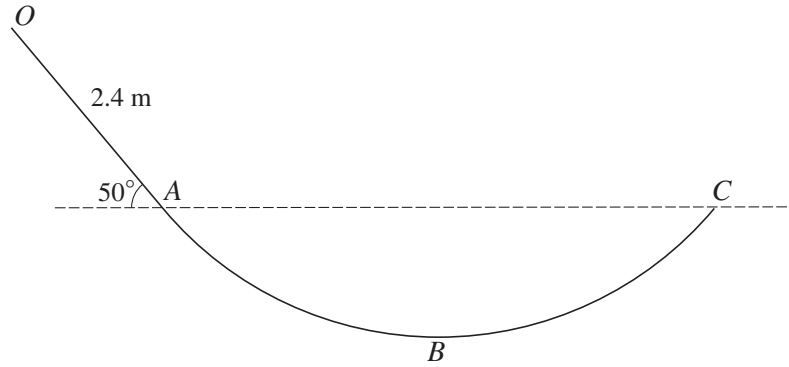
(ii) Hence find the power being applied to the block, giving your answer to the nearest  $\text{kW}$ . [1]

**3**



Three horizontal forces of magnitudes  $F \text{ N}$ ,  $13 \text{ N}$  and  $10 \text{ N}$  act at a fixed point  $O$  and are in equilibrium. The directions of the forces are as shown in the diagram. Find, in either order, the value of  $\theta$  and the value of  $F$ . [5]

4



$OABC$  is a vertical cross-section of a smooth surface. The straight part  $OA$  has length 2.4 m and makes an angle of  $50^\circ$  with the horizontal.  $A$  and  $C$  are at the same horizontal level and  $B$  is the lowest point of the cross-section (see diagram). A particle  $P$  of mass 0.8 kg is released from rest at  $O$  and moves on the surface.  $P$  remains in contact with the surface until it leaves the surface at  $C$ . Find

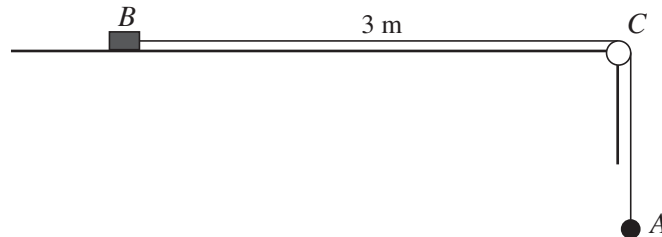
(i) the kinetic energy of  $P$  at  $A$ , [2]

(ii) the speed of  $P$  at  $C$ . [2]

The greatest speed of  $P$  is  $8 \text{ m s}^{-1}$ .

(iii) Find the depth of  $B$  below the horizontal through  $A$  and  $C$ . [3]

5



A block  $B$  of mass 0.6 kg and a particle  $A$  of mass 0.4 kg are attached to opposite ends of a light inextensible string. The block is held at rest on a rough horizontal table, and the coefficient of friction between the block and the table is 0.5. The string passes over a small smooth pulley  $C$  at the edge of the table and  $A$  hangs in equilibrium vertically below  $C$ . The part of the string between  $B$  and  $C$  is horizontal and the distance  $BC$  is 3 m (see diagram).  $B$  is released and the system starts to move.

(i) Find the acceleration of  $B$  and the tension in the string. [6]

(ii) Find the time taken for  $B$  to reach the pulley. [2]

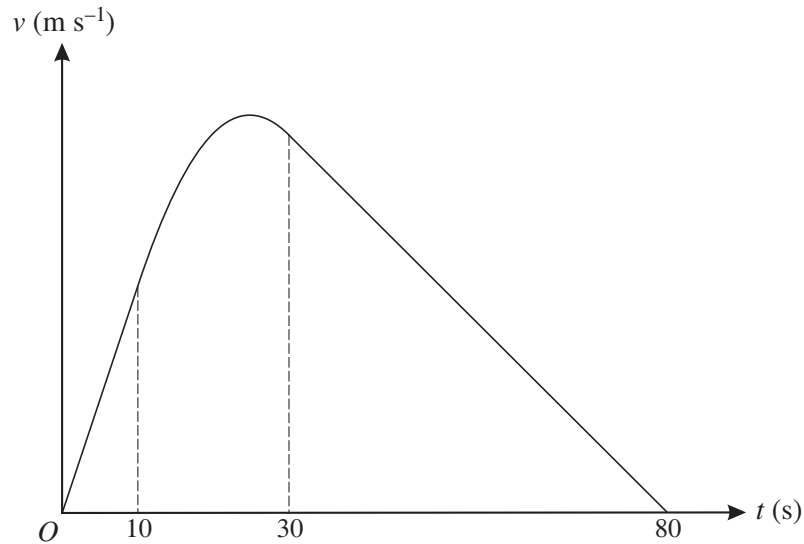
6 A particle  $P$  of mass 0.6 kg is projected vertically upwards with speed  $5.2 \text{ m s}^{-1}$  from a point  $O$  which is 6.2 m above the ground. Air resistance acts on  $P$  so that its deceleration is  $10.4 \text{ m s}^{-2}$  when  $P$  is moving upwards, and its acceleration is  $9.6 \text{ m s}^{-2}$  when  $P$  is moving downwards. Find

(i) the greatest height above the ground reached by  $P$ , [3]

(ii) the speed with which  $P$  reaches the ground, [2]

(iii) the total work done on  $P$  by the air resistance. [4]

7



An object  $P$  travels from  $A$  to  $B$  in a time of 80 s. The diagram shows the graph of  $v$  against  $t$ , where  $v \text{ m s}^{-1}$  is the velocity of  $P$  at time  $t$  s after leaving  $A$ . The graph consists of straight line segments for the intervals  $0 \leq t \leq 10$  and  $30 \leq t \leq 80$ , and a curved section whose equation is  $v = -0.01t^2 + 0.5t - 1$  for  $10 \leq t \leq 30$ . Find

(i) the maximum velocity of  $P$ , [4]

(ii) the distance  $AB$ . [9]

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